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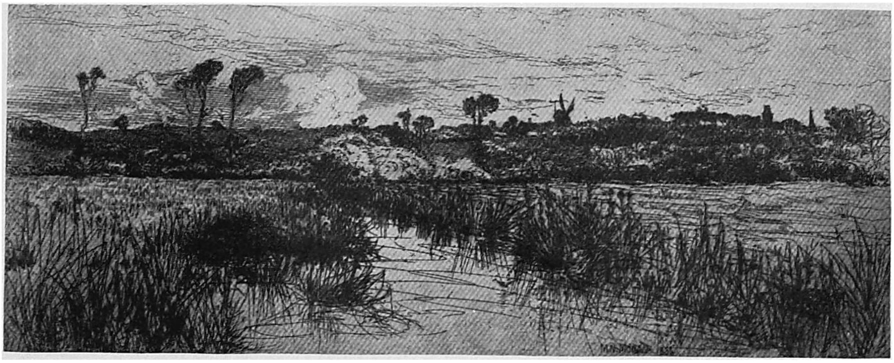
experimental plates admitted to the exhibition of the New York Etching Club, and in winning her way to membership in the London Society of Painter-Etchers, and as late as 1893 she was accorded a medal and a diploma for etchings at the Columbian Exposition in Chicago. From first to last her work showed no evolution or marked change. She never regarded herself as a professional, but looked upon her art as a pleasant accomplishment, and the excellence she attained was simply the outcome of her love of the art.

MORRIS T. EVERETT.



HAUNT OF THE MUSKRAT
By Mrs. Mary Nimmo Moran

AMERICAN ART INDUSTRIES—V

REPRODUCTION OF PICTURES BY THREE-COLOR PROCESS

One of the most remarkable achievements of recent years in the art of printing is the perfection of the three-color process, by which paintings or other colored pictures can be reproduced, often with absolute and always with approximate fidelity to the originals. To-day this class of art work is so common as to have lost its novelty. Colored reproductions of pictures are used in books, in magazines, in business circulars, as supplements to newspapers. One finds them everywhere, and often with a degree of excellence that makes them marvels of beauty.

To the public, however, the manner of their production is one of the mysteries of the art industries. To the uninitiated the three-color process is little more than a name for an admirable result. In a general way it is known that pictures such as the two accompanying this article require three printings, and that the different inks used are red, blue, and yellow. But beyond this the knowledge of the average layman does not extend.

If he should see the three plates from which the different printings are made, they would look so nearly alike that he could not distinguish one from the other, and yet the combined impressions of the three plates, each imparting to the page its one color, give every variation of hue used by the artist, who in painting the picture laboriously mixed his paints on a palette to produce the desired effect. By what trick of mechanism can three metal plates be so manipulated as to preserve faithfully the outlines of a picture and maintain intact all of its color values—the reds, for instance, merging by proper gradations into russets or pinks, the purples fading into violets or blues, the oranges changing into yellows or buffs, and the greens varying from the intensest to the weakest shades?

The accompanying color-prints—no apology is needed for their reappearance in Brush and Pencil, since they are designed here to subserve a specific purpose—are admirable illustrations of the artistic results obtained by this process. Neither of the pictures gives more than a mere hint of the three colors used in its production. The red, blue, and yellow inks are disguised, blended into an artistic aggregation of other shades. It is the purpose of this article to explain how mechanism pure and simple duplicates the studied, painstaking efforts of the artists.

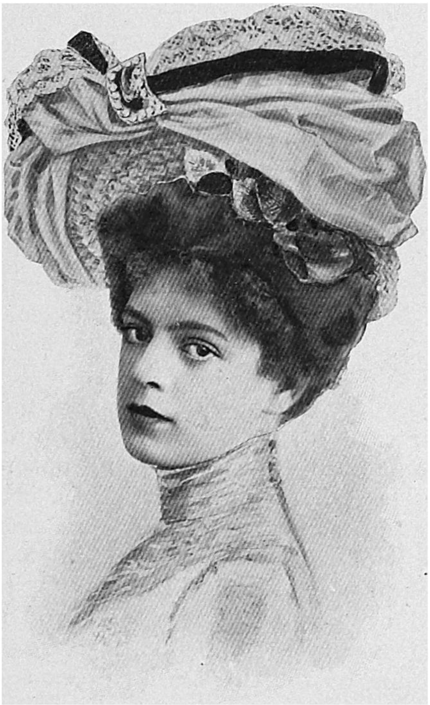
Colored photography has been the dream of a century, ever since Ritter, of Jena, noticed that the various rays of the spectrum differed considerably in their action upon chloride of silver. This observation was made in 1801, and young as three-color printing is, it is the direct but tardy fruit of this casual observation. To trace the work of different experimenters here would be out of place, and a minute technical discussion of theories and practices would be equally foreign to the purpose of the article. Only enough detail, therefore, will be given to explain the underlying principle and make clear the various steps in the production of a picture by the three-color process.

The old division of white light into its primary constituent colors was violet, indigo, blue, green, yellow, orange, and red, but it is a truism of to-day that of these seven four may be discarded. The remaining three, blue, yellow, and red, make white light, and by the proper mixture of these three every conceivable color can be produced. This fact is the basis of the three-color process in printing, and the men who perfected the method had before them the task of devising a mechanical way of mixing inks of the three colors named on a page so that the overlapping of the colors would produce the proper shades in the proper places, thus preserving the details of the picture as a drawing and at the same time correctly reproducing its color scheme.

A close inspection of the accompanying color-plates—"The Mesa, from Kit Carson's Tomb, Taos, New Mexico," by J. H. Sharp, and "The Bal Bullier, Luxembourg Gardens," by Frank X. Lyendecker—

in which the most delicate shades are reproduced with remarkable faithfulness to the originals, might naturally give one an exaggerated idea of the difficulty attending the feat of stamping red, blue, and yellow on a sheet of paper so as to produce the results obtained. Really the feat is not such a difficult one.

It is a fact well known to the student of physics that red light and green light unite to make yellow, that blue light and green light produce peacock blue, that blue light and yellow light make white, and so on with different results throughout the various combinations to which the three primary colors and their modifications are susceptible, the tint or resulting color depending upon the relative proportions of the constituent colors that enter into its composition. It is also a well-known fact that white light can be sifted so as to strain out, if one may use the phrase, certain of the constituent elements so as to give the transmitted portion of the light an entirely different hue. Here, then, was the basis for experimenting.

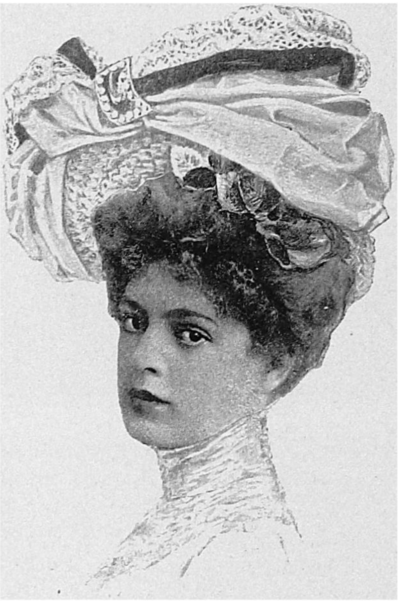


HALF-TONE FROM COLORED ORIGINAL
Made with White Light

If by some clever means it were possible to take a photograph of a colored object and sift out the blue and yellow elements of the white light by which it is ordinarily seen, the result would be a picture in which the red constituent of the light played an exaggerated part. If a similar photograph were taken and the red and yellow elements were sifted out, the blue element would be exaggerated in the picture. If, again, another photograph were taken and the red and blue elements were sifted out, the yellow element would predominate in the result. It will thus readily be seen that, in a sense, it would require a superposition of the three pictures thus taken one upon the other to restore the proper values of the different colors in the original.

In other words, we would have three transcripts of a colored object, each lacking something to be found in the other two. If these three transcripts, therefore, were transformed into three printing surfaces, we might reasonably expect them to stamp the three primary colors on a page in the proper proportions so that the superposition of the three colors one upon the other would produce the varying shades of the original object. That is exactly what is done in three-color printing.

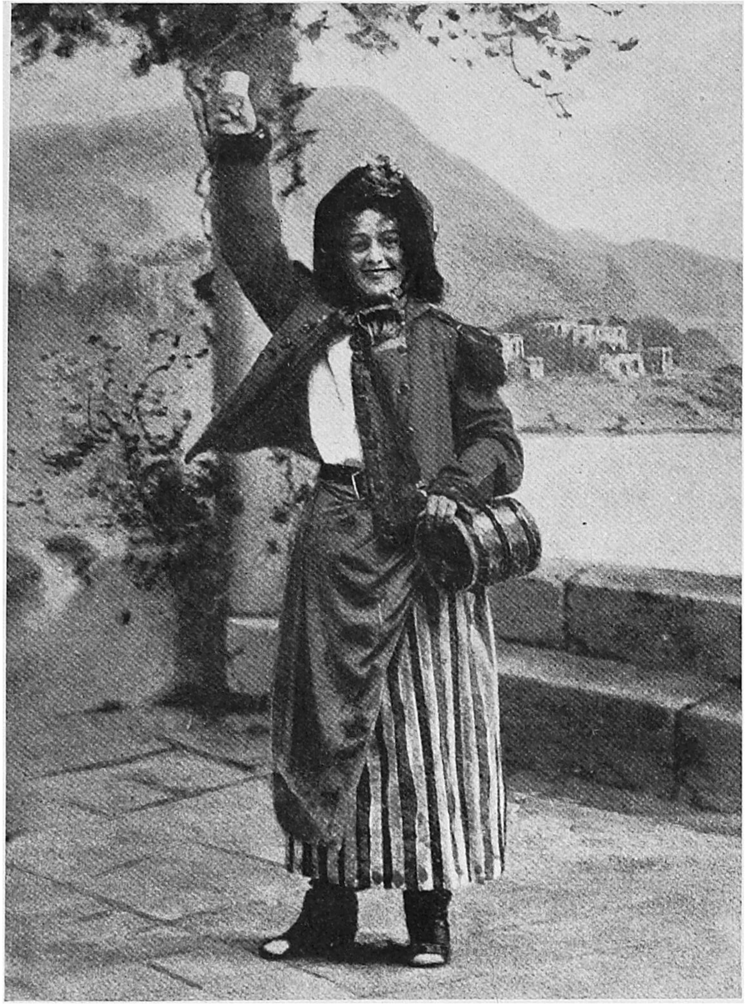
The accompanying color-plates were printed from three half-tone plates, made, as just said, in such a way that each emphasizes one of the primary colors and subordinates the other two. The art of making a half-tone plate, such as the illustrations in Brush and Pencil are printed from, was fully explained in a recent issue of the magazine, and need not here be repeated in detail. It is only necessary to recall that the half-tone is simply a metal plate whose surface consists of innumerable dots and intervening spaces, the dots being larger and the intervening spaces narrower in the dark portions of the picture, and the dots being smaller and the intervening spaces wider in the light portions.



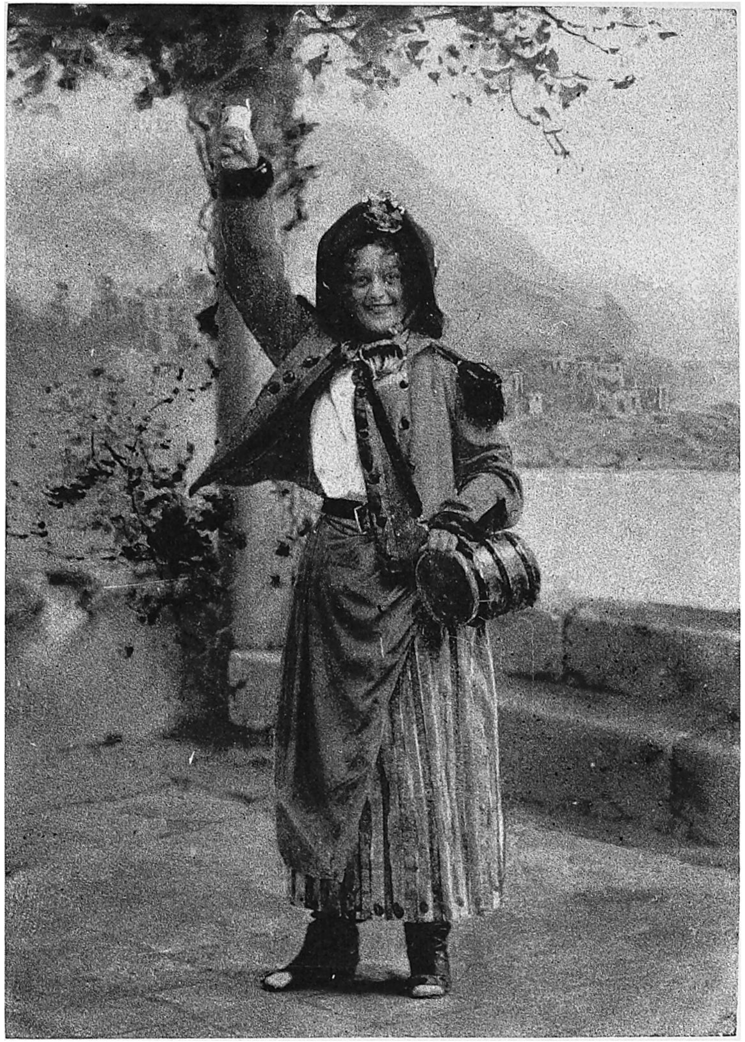
YELLOW PLATE FOR COLOR WORK
Made with Violet Light

The half-tone plates used in three-color work are essentially of the same character, and so far as the mere mechanical process is concerned are made practically in the same way. The main difference is in the lights used in making the three plates.

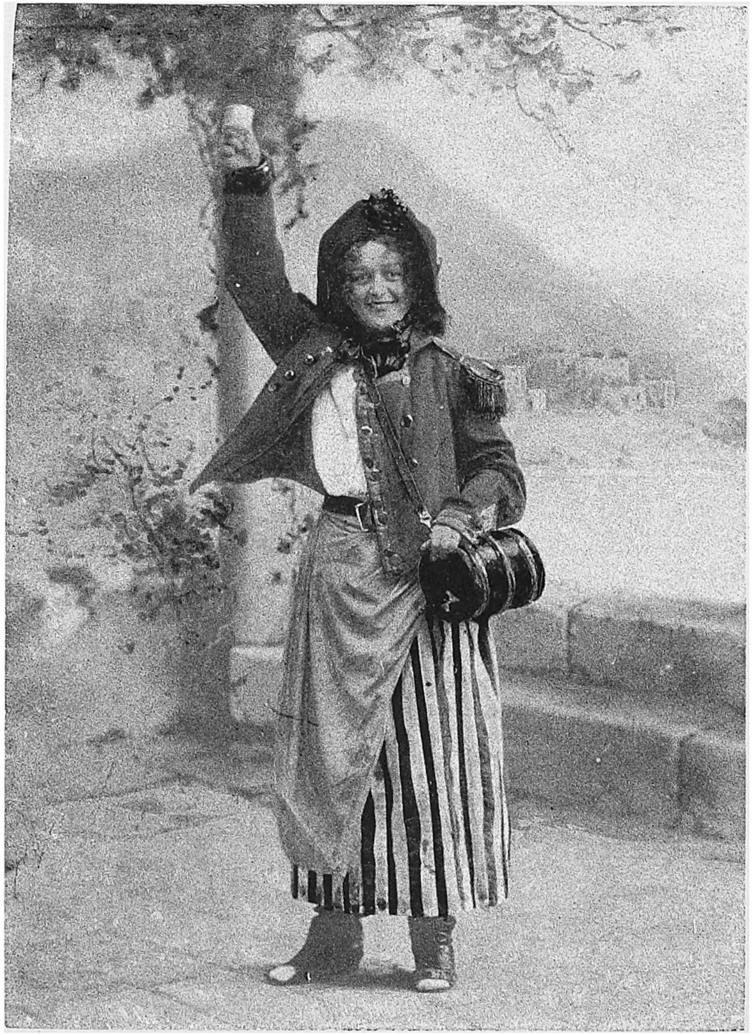
In the actual production of a three-color print, the yellow is printed first, then the red, and lastly the blue. In making the photograph



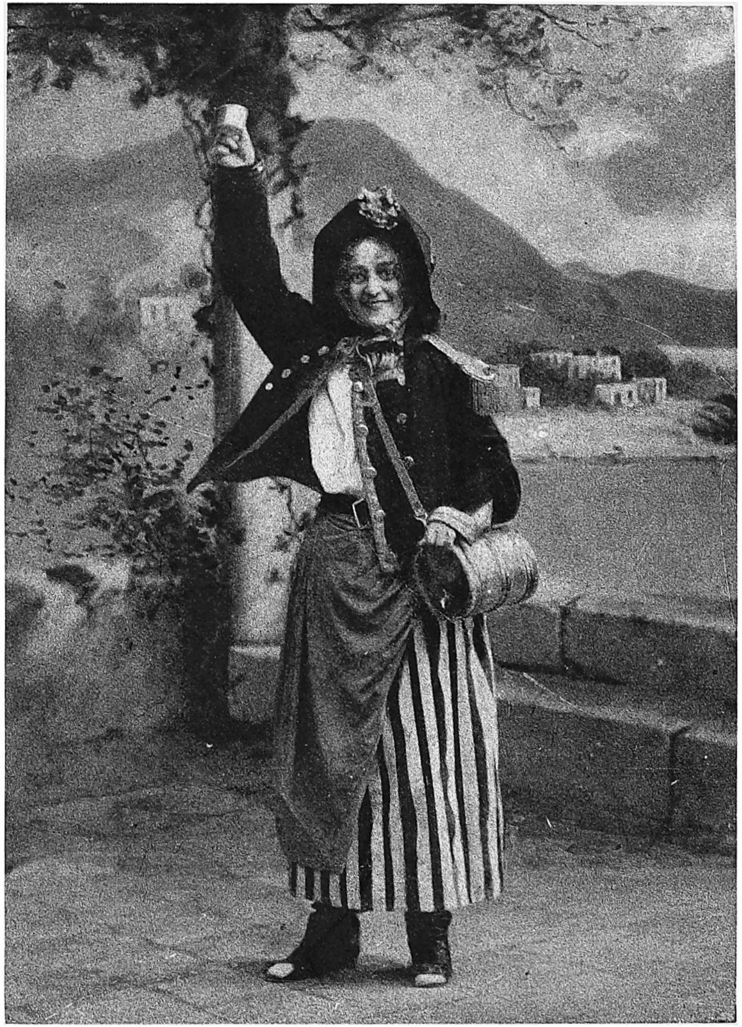
HALF-TONE PLATE FROM COLORED ORIGINAL
Made with White Light



YELLOW PLATE FOR COLOR WORK
Made with Violet Light

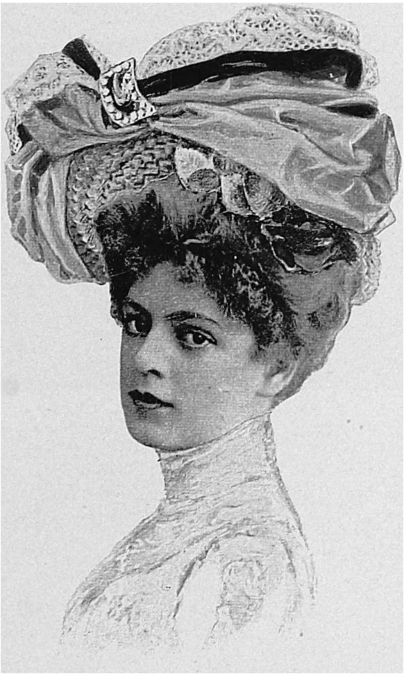


RED PLATE FOR COLOR WORK
Made with Green Light



BLUE PLATE FOR COLOR WORK
Made with Red Light

of the colored object from which the yellow plate is made, violet light is used, since this color cuts off or reduces the other colors found in the original. In making the photograph for the red plate, green light is used, since this cuts off the other colors and emphasizes the red; and in making the photograph for the blue plate red light is used, since this reduces the other colors and emphasizes the blue. We have now three photographs with the color values distorted, which are called color record negatives.



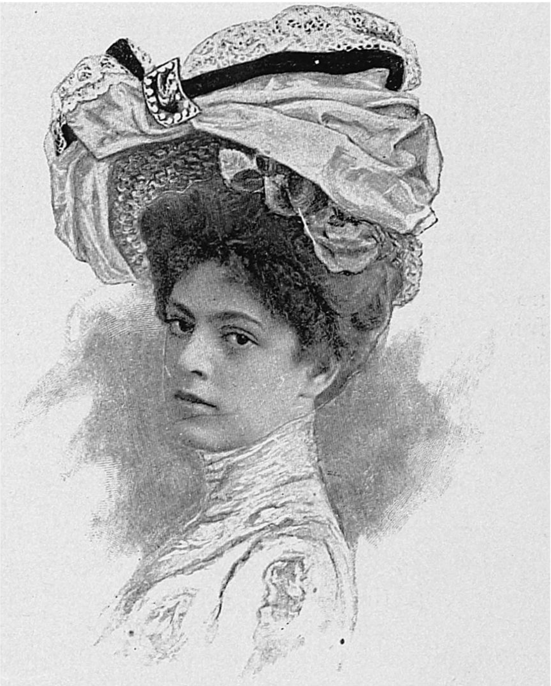
RED PLATE FOR COLOR WORK
Made with Green Light

In making these record negatives the violet, green, and red light is furnished simply by inserting between the object and the lens of the camera a perfectly even plate of glass of the requisite color, or a flat jar containing a liquid colored to the proper tint. The rays of white light reflected from the object photographed are sifted by the colored medium through which they pass and fall upon the sensitized surface of the plate prepared to receive the impression in such a way as to produce the disturbance of color values.

From these record negatives, record positives are then made, just as positives are made from negatives in an ordinary case of photography, and from these record positives half-tones are made, just as has already been described in these pages. We now have three plates with good printing-surfaces, each tolerably faithful to the original colored picture in point of outline, but each essentially different from the other in its shadings.

The impression of one plate is printed directly upon the other, the utmost care being taken to preserve the register; that is, to make a given point in one impression fall exactly upon the same point in the others. The impression with yellow ink is made, and allowed to dry. On this is printed the red impression, the superposition of the red upon the yellow largely killing the first color and markedly modifying the red itself. Upon this combination of red and yellow the blue impression is made, and the picture is again transformed. The red overlapping the yellow destroys the first color, except where it should remain comparatively strong, and the blue overlapping the two previous colors supplies the remaining constituent of the white light by which the spectator sees the picture.

The result is that yellow, blue, and red only appear in the finished picture where they appeared in the originals reproduced. In all other portions of the picture, by mere superposition of one upon another, the three primary colors have disappeared. In some portions they have been changed into entirely different colors, in others they have been modified into shades or tones of some one of the primary colors used.


BLUE PLATE FOR COLOR WORK
Made with Red Light

In "The Mesa," for instance, the reader will notice delicate and pronounced greens. No green ink was used in the printing, the greens resulting in the picture from the mixing of the three colors actually used. The mountain-peaks in the distance are clothed in purples of different shades. These tones again result from combinations.

In the "Bal Bullier," the stonework of the fountain appears in the picture a natural stone color, while the horses and the reflection of the horses in the water are a pronounced green. Both these colors, as well as the grayish blue water in the immediate foreground and the twinkling white lights in the background, are derived colors. One might suppose that the gas and the electric lights in the distance were simply the white paper showing through the various impressions. In reality, the white is simply the superposition of red and blue upon yellow.

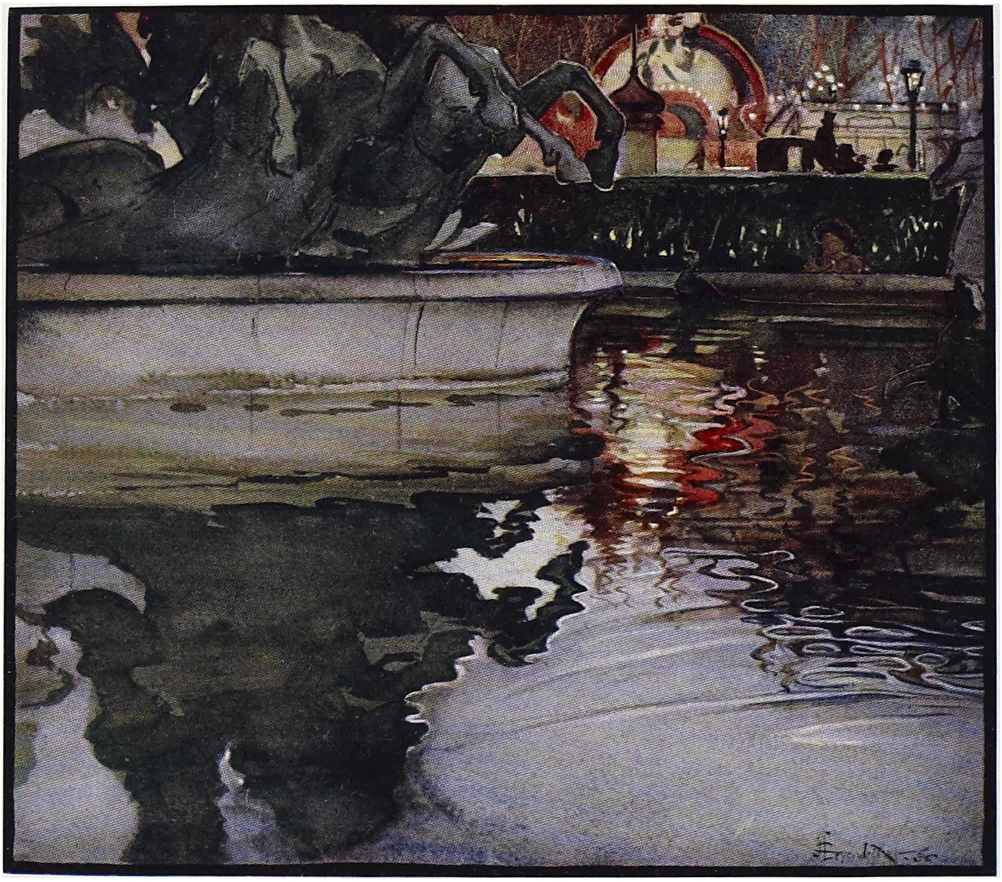
For the purpose of comparison, two sets of four plates each of the same picture are supplied. In each set, one plate, so marked, is simply a half-tone showing the result when the various colors of the original are properly co-ordinated by white light in the manufacture of the plate. The other three in each set are, respectively, the yellow, red, and blue plates made for the actual work of producing a colored reproduction. It needs but a casual inspection by the reader to see the most pronounced differences in the shadings of the different plates.

In the picture of the peasant-girl, for instance, the mountain in the distance is barely visible in the red plate, while in the blue plate it is very pronounced. In the finished picture the mountains are a hazy blue. The stonework in the red plate is very light, while in the yellow plate it is comparatively dark. In the finished picture the stonework is a brownish gray. A very marked difference will be noticed in the shading of the foliage at the base of the tree, it being faint in the red plate, darker in the blue, and darkest in the yellow. In the finished picture red is almost eliminated; the foliage is russet where the yellow plate is densest and green where the deepest shadings of the blue plate have fallen.

And so in the comparative plates of the woman's head. The half-tone plate shows the various colors of the original properly co-ordinated. In the other three plates the emphasis given, respectively, to the yellow, blue, and red can easily be detected. Naturally, the face of the picture should be white. In the half-tone made with white light the face is white. In each of the other plates the face is dark, yet when the red and blue plates are superimposed upon the yellow plate in the process of printing the union of the three makes white. Consequently, while the face is dark in the impressions given by each of these plates separately, the result of all three impressions, one upon the other, produce a white face.

To burden this article with the details that would have to be taken into consideration by the practical worker in producing a colored reproduction would be but to confuse the reader. A popular account for the intelligent reader, and not an exhaustive explanation, is all that is intended. One point of detail, however, further than has been given must not be omitted.

In making the half-tones for the different color-plates, apart from filtering the light in making the color record negatives, the main point of departure from the ordinary method of half-tone manufacture is in the fact that the screens for the different plates are set at different angles. It will be remembered that in making a half-tone plate the surface of the picture is broken up into dots and spaces—the tooth to



"THE BAL BULLIER," LUXEMBERG GARDENS

CHICAGO COLORTYPE CO.,

make the impression upon the paper—by being photographed through a finely ruled pane of glass called a screen. In making the three plates for color-work it has been found that the best results are obtained when the screen for the second plate is turned to an angle of thirty degrees from the first, and the screen for the third plate to thirty degrees from the second.

There is thus less interference with the colors, the red, blue, and yellow dots of the different half-tones falling in such a way as to produce the most brilliant and luminous effect. The massing of colors by superposition is in no wise affected by thus setting the lines of the screens at an angle, since at whatever angle the screen may be set, the dense portions of the photograph will be dense in the plate, while, on the other hand, the different colored dots falling minutely out of register give life to the picture and enhance by its beauty.

In conclusion, it may be said, by way of recapitulation, that every colored picture, like the two accompanying this article, requires in all fifteen operations. First, it is necessary to take three color record negatives to emphasize each of the three primary colors in a single photograph. From these three record positives must be made as in ordinary photography. Then three screen negatives are made, followed by the manufacture of three half-tone plates. And lastly, there must be three printings, one each with the three different colored inks. There are processes by which some of these intermediate steps may be eliminated, as, for instance, the grain process. These short methods, however, are the exception, the full number of steps being usually taken in ordinary art and commercial three-color work.

FREDERICK W. MORTON.

JAPANESE HAND-CUT STENCIL
Collection of H. Deakin